XXIII. THE EFFECT OF COLD STORAGE ON THE CARNOSINE CONTENT OF MUSCLE.

By WINIFRED MARY CLIFFORD.

From the Physiology Department, Household and Social Science Department, Kensington.

(*Received February 1st, 1922.*)

The flavour of meat has long been believed to be associated with the presence of extractives, although whenever isolated in a pure condition such substances are tasteless. However one extractive—β-alanyl-histidine or carnosine—does disappear in cold storage and this may account for the inferior flavour of imported meat when compared with home-killed.

The idea of such a disappearance was suggested by differences found when estimating carnosine in various samples of beef, by a colorimetric method previously described in this journal [Clifford, 1921]. Research on this extractive was begun just after the war when the beef commonly available was imported. Such samples gave yields of 0·35–0·37 % carnosine. On one occasion some English steak was obtained and gave the unexpectedly large yield of 1·1 %. It has been shown that for a given species the carnosine content of muscle is constant [Clifford, 1922] and the great difference between English and imported beef could not be explained unless cold storage had effected a reduction of the base. In order to test this various samples of English and imported meats were analysed.

Carnosine content of English and imported meat.

Beef.

Twelve separate samples of English beef have been examined over a period of two years with the following results: 1·1, 1·0, 1·1, 0·98, 0·96, 1·0, 0·97, 0·98, 1·1, 0·98, 0·98, 0·97 %. Average 1·0 %.

Five samples of imported beef gave: 0·37, 0·34, 0·36, 0·35, 0·36 %. Average 0·356 %.

Similar experiments have been carried out on veal, mutton and lamb and in every case the carnosine content of imported meat has been very much lower than that of English meat. Actual figures obtained were:

	English		Imported	
Beef	0·96–1·1 %	(12 samples)	0·34–0·37 %	(5 samples)
Veal	1·05–1·12	(5 ,,)	0·34–0·36	(4 ,,)
Mutton	0·37–0·38	(3 ,,)	0·13–0·16	(2 ,,)
Lamb	0·40–0·42	(2 ,,)	0·15–0·16	(2 ,,)

In all these experiments about one-third of the carnosine value was found in the imported meats as compared with English killed.

EXPERIMENTS ON THE EFFECT OF COLD STORAGE ON MEAT.

Since all the samples of imported meat were perfectly fresh and in an edible condition, the loss of carnosine could not be a putrefactive change, but might have been due to the length of time the meat had been in cold storage.

It was possible to test this idea owing to the kindness of Dr H. H. Dale who allowed a sample of English meat to be placed in a cold room in the Research Institute at Hampstead. Portions were removed at various times for analysis. When first put in, carnosine was present to the normal value of 0·99 %. Samples were taken at intervals of about one month. A fall of carnosine at first great, then slight, followed by a second steep fall was shown (Fig. 1).

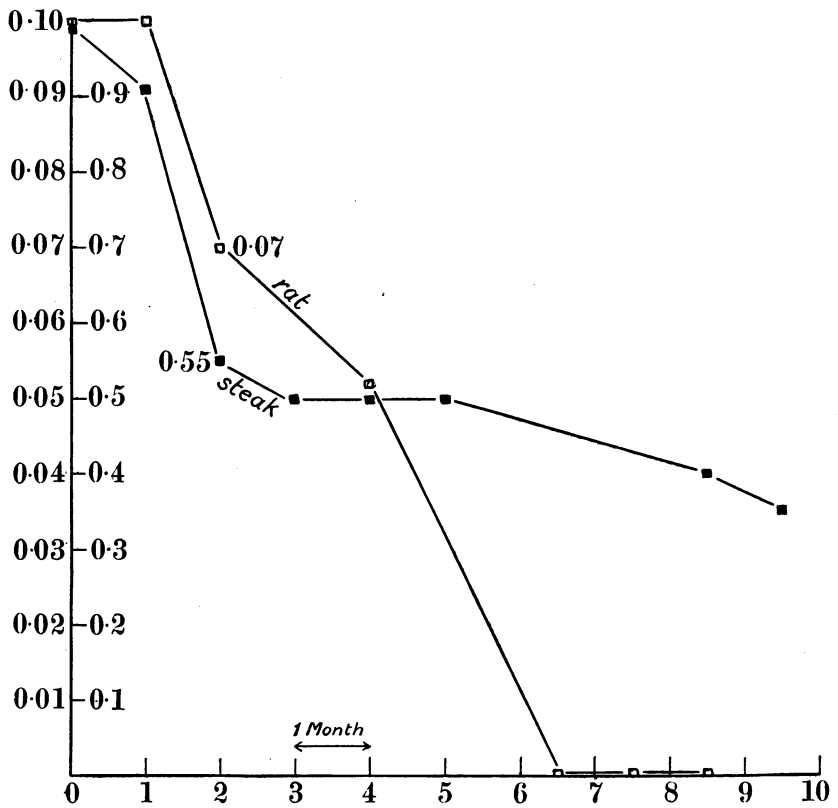

Fig. 1.

The actual figures were:

Original	0·99 % carnosine		4 months	0·50 % carnosine	
1 month	0·90	,,	6 ,,	0·48	,,
2 months	0·55	,,	8½ ,,	0·40	,,
3 ,,	0·50	,,	9½ ,,	0·35	,,

Effect of cold storage on rat muscle.

The loss of carnosine in beef might have originated in some process which took place before the meat was put into the cold room. Therefore seven rats were killed with coal gas and put into cold storage immediately after death. The normal value of 0·11 % carnosine was given by one animal, estimated directly, and the others were removed at intervals. The curve of carnosine loss ran parallel with that for beef for a period of four months (Fig. 1). This was followed by a steep fall in the fifth month and by six and a half months all trace of the base had disappeared.

Results were:

Original	0·11 % carnosine	6½ months	Absent
1 month	0·11 ,,	7½ ,,	,,
2 months	0·07 ,,	8½ ,,	,,
4 ,,	0·052 ,,		

The above experiment shows that loss of carnosine occurs in muscle put into a cold room directly after the death of the animal in a similar manner to that shown by bought English meat kept at the same temperature.

The temperature of the cold room was just below 0° C. Spicules of ice were found in every sample analysed and the extractions were made before thawing out had completed.

Discussion of results.

From experimental results it may be stated that measurement of the depth of red colour produced on diazotising carnosine in a watery muscle extract gives an easy and rapid test for distinguishing between English fresh killed and cold storage meats. A sample of beef or veal with a carnosine percentage below 0·8 % or of mutton or lamb below 0·3 % would not come from a freshly killed animal, but probably from a carcase which had been chilled in order to preserve it. If the percentage were as low as 0·3 % in the case of beef or 0·15 % with mutton the sample would be 9–12 months old. Further experiments are in progress with the object of obtaining a curve by which the age of cold storage meat may be read off after determining the carnosine content.

The mechanism causing the loss of carnosine is unknown, but experiments are being carried out to investigate the problem. Since the reaction takes place at freezing point it is improbable that bacterial or enzyme action can account for the change, which is more likely to be initiated by a simpler type of catalyst.

Thanks are due to Dr H. H. Dale for allowing the meat to be deposited in the cold room at the Research Institute, Hampstead, and to Prof. V. H. Mottram for suggestions during the course of the work.

The expenses of this research were defrayed by the Medical Research Council.

REFERENCES.

Clifford (1921). *Biochem. J.* **15**, 400.
—— (1921). *Biochem. J.* **15**, 725.